As in other embodiments a reflected beam **122** forms an image **124** of the probe lever **116** at a point which does not appear to move in the X and Y directions, notwithstanding that the probe lever **116** moves in the X and Y directions. In this embodiment, a wedge shaped optical element **126** has added to offset and rotate the incoming light beam **128** as well as the light beam **122** which is reflected from the probe lever **116**. This rotation compensates for the angle from the horizontal at which probe lever **116** may be mounted. Such an angle is convenient in order to prevent points of the probe lever **116** other than the tip from touching the sample **130** surface. By positioning light beam **128** on one side of the lens **118**, the optical element **126** can be eliminated.

As will be appreciated by those skilled in the art, this rastered probe scanning force microscope **110** can be placed on large structural samples **130** and can then be used to image various areas of the surface of large objects such as mirrors, lenses, and structural members, by scanning locally at selected locations to investigate the surface features with the probe lever **116**.

The rastered probe force microscope **110** can be mounted on a support structure (not shown) which, in turn, can rest on the sample **130** and can be moved around over the sample **130**. By this method, composite mosaic images can be created from the surface of very large samples.

In further variations of the present invention, four or more photo-diodes **132** can be employed such that twisting or torque applied to the probe lever **116** can be detected, as well as any vertical deflection of the probe lever **116**, as described above.

The present invention may also be used with means for exciting a probe into vibration at or near its resonant mode such that, as the probe nears the sample surface, changes in the resonant parameters (such as amplitude or phase) may be detected and used as a signal to control the Z displacement of the scanning device.

Others skilled in the art may devise different and alternative embodiments of the present invention. Accordingly, the scope of the invention should be limited only by the claims presented below.

What is claimed as new is:

1. A scanning force microscope device comprising in combination:

a. a sensing probe having a substantially reflective surface on one side and a scanning tip on the opposite side, said tip adapted to be positioned adjacent a surface to be scanned;

b. illuminating means positionally decoupled from said sensing probe and independent of probe motion for generating a radiant energy beam and for applying said beam to said reflective surface;

c. position control means coupled to said sensing probe for moving said scanning tip substantially parallel to a surface to be scanned in a predetermined pattern and for moving said scanning tip orthogonal to the surface to follow the contours of the surface;

d. beam positioning means adapted to receive said radiant energy beam from said illuminating means for directing said radiant energy beam to said reflective surface to follow said sensing probe through lateral motion of said probe; and

e. detector means adapted to receive the energy beam reflected from said reflective surface and operable in response to movement of said reflected energy beam corresponding to position changes of said sensing probe relative to the surface to be scanned to produce a motion representing signal corresponding to tip movement following the contours of the scanned surface,

whereby tip motion in a direction orthogonal to scanning motion results in a series of electrical signals corresponding to and representative of the surface contours of the scanned surface. surface.

2. The microscope device of claim **1** wherein said illuminating means include a laser.

3. The microscope device of claim **1** wherein said illuminating means include a lens for focussing said energy beam to said reflective surface.

4. The microscope device of claim **3** wherein said lens narrowly focuses said radiant energy beam at said scanning probe reflective surface.

5. The microscope device of claim **1** wherein said detecting means are comprised of at least two photodetecting cells.

6. The microscope device of claim **1** further including compensating means for correcting for errors at said detection means resulting from lateral movement of said reflective surface.

7. The microscope device of claim **6** wherein said compensating means include a lens and further include computer means employing software algorithms operable in response to applied detector means signals for compensating for errors arising from scanning tip lateral movement.

8. The microscope device of claim **1** wherein said beam positioning means include a directing lens and lens moving means independent of said position control means for moving said lens in coordination with tip motion.

9. The microscope device of claim **1** wherein said beam positioning means include a directing mirror and mirror moving means independent of said positioning means for moving said mirror in coordination with tip motion.

10. In a scanning force microscope having a sensitive probe with a tip mounted for movement in response to relative vertical distance changes between the sensing tip and a sample surface as the tip moves laterally with respect to the sample surface, apparatus for sensing the vertical movement of the tip relative to the surface being scanned and for creating a signal representative of such vertical movement comprising:

a. a reflective surface carried by the sensitive probe tip;

b. an energy source positionally decoupled from lateral movement of the sensitive probe tip for emitting a radiant energy beam including focussing means for applying said beam to said reflective surface;

c. control means for moving the sensitive probe tip laterally in a raster fashion over the surface of a sample to be scanned and including beam directing means for causing said radiant energy beam to follow the motion of the probe tip;

d. driving means for moving the sensitive probe tip in a vertical direction towards and away from the surface of the sample to be examined; and

e. detection means positioned to receive said energy beam after reflection from said reflective surface for signalling changes in the beam position, said changes corresponding to and representative of